User Manual: Digital Image Correlation (DIC) Target Speckle Size Calculator and Pattern Lookup Tool

Tool Reference

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User Manual: Digital Image Correlation (DIC)
Target Speckle Size Calculator and Pattern Lookup Tool

Background

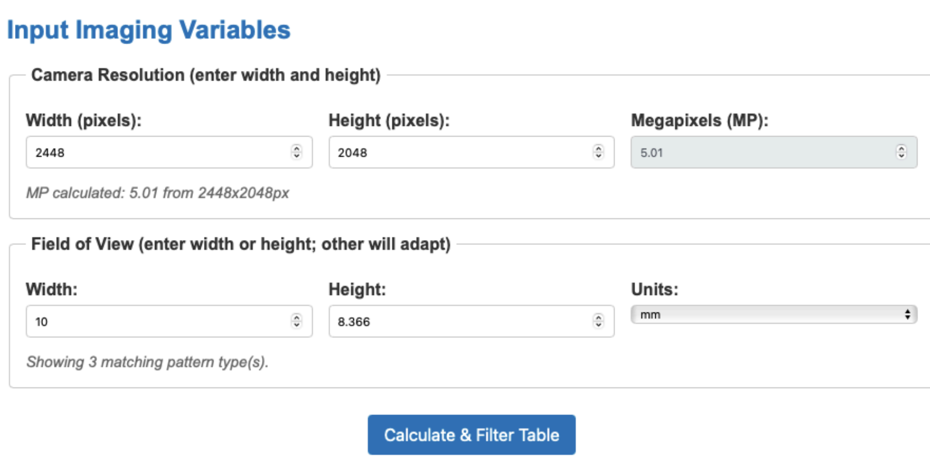
Digital image correlation (DIC) compares pixel intensities in digital images to extract full-field measurements of surface displacements and strains. The technique is influenced by the quality of the speckle pattern applied to the specimen surface. Published studies indicate that speckle diameters in the range of 3–7 pixels are associated with optimal correlation performance (e.g., see [1], Section 10.1.3.1). Speckles that are too small generate aliasing as they move across the imaging sensor, reducing correlation confidence and increasing noise in extracted deformation data. Speckles that are too large require larger subsets, reducing the spatial resolution of extracted displacement and strain data and potentially smoothing out fine-scale field gradients.

This Regulatory Science Tool (RST) facilitates the identification of the ideal speckle size for DIC experiments based on the selected camera resolution and the spatial field of view. The tool also suggests candidate patterning techniques based on the identified target speckle size. For additional details and examples of mentioned patterning techniques applied to implantable medical devices or medical device surrogate specimens, see the supporting manuscript Rothermel et al (2025) [2].

Using the Tool

To use the tool, fill your 1) camera resolution width and height in pixels and 2) spatial field of view values in units of your choice selected from the drop-down menu. Note the aspect ratio is inferred from the camera resolution values, so only a width or height need to be specified for the spatial field of view.

Click “Calculate & Filter Table” to proceed:



The effective image spatial resolution and target speckle size will then be calculated and displayed, along with a visualization of the target speckle size in notional digital speckle patterns displayed at varying spatial scales spanning several orders of magnitude.

Outputs

Spatial Resolution: 4.085 µm/pixel

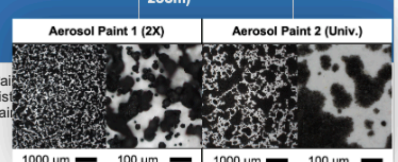
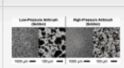
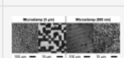
Target Speckle Size (3-7 pixels): 12.3 - 28.6 µm

A calculated target speckle size of **20.4 µm** is on the order of fine surface texture on the quarter's surface.

Top row: Representative digital speckle patterns visualized at varying spatial scales with speckles dimensions matching target size calculated based on input parameters.
Bottom row: Scaled U.S. Quarter (diameter ≈ 24 mm) for comparison (image source: usmint.gov).

The speckle patterning table at the bottom will also dynamically update to suggest appropriate patterning methods based on the calculated target speckle size. Within the table, you may hover your cursor over representative speckle images to zoom in on details of the example patterns (e.g., see zoomed "Aerosol Paints" panel below).

Suggested Patterning Techniques

Speckle Type	Typical Speckle Size Range	Pros	Cons	Influential Parameters	Representative Pattern Images (mouse over to zoom)	Additional References
Aerosol Paint	10 - 2000 µm	Easy to apply, inexpensive, wide range of possible speckle size, readily available, deformable.	Relatively large speckles, less control over coverage, less uniform size, nozzle clogging, inconsistent and operator-dependent patterns.	Pai dist pai		al. (2020)
Airbrush Paint	5 - 1000 µm	Easy to apply, inexpensive, wide range of possible speckle size, deformable.	Some equipment required, inconsistent and operator-dependent patterns.	Paint brand, spray distance, air pressure, nozzle size, paint viscosity, paint finish, flow rate.		• Dickinson et al. (2012) • Ghosh et al. (2012) • Senol et al. (2021)
Micro- or Nano-stamps	0.5 - 15 µm	Easy to customize, consistent, repeatable, durable, can generate sub-micron pattern features.	Moderate cost, difficult to apply to curved or unpolished surfaces, possible smearing of features, moderate application complexity.	Sample material, chosen speckle pattern, surface texture, sample geometry, stamp media.		• Cannon et al. (2015) • Wisner & Kontsos (2018)

References

[1] Sutton, M. A., Orteu, J. J., & Schreier, H. (2009). *Image correlation for shape, motion and deformation measurements: basic concepts, theory and applications.* Springer Science & Business Media. doi: 10.1007/978-0-387-78747-3.

[2] Rothermel, T.M., Mirmohammad, H., Weaver, J.D., Porter, D.A., Nguyen, M., He, Z., Cannon, A.H., Hochhalter, J.D., & Aycock, K.I. (2025). Full-Field Strain Measurements on Medical Devices Using Digital Image Correlation: Considerations and Practical Examples. *Journal of the Mechanical Behavior of Biomedical Materials*, doi: 10.1016/j.jmbbm.2025.107020.